

What is claimed is:

1. A device comprising means for storing instructions, said instructions adapted to be executed by a processor of a computer, said instructions when executed by the processor executing a process comprising the steps of
- 5 (a) obtaining a first data set, the first data set comprising at least one of the following:
- time history of fluid volumes,
 - time history of proppant volumes,
 - 10 fluid properties,
 - proppant properties, and
 - geological properties,
- (b) providing the first data set to a computer, the computer having a processor capable of executing
- 15 instructions, the computer further having electronic storage means with stored equations comprising hydraulic fracturing relationships,
- (c) computing by said processor a first set of values by manipulating said first data set using said stored
- 20 equations,
- (d) determining from said first set of values dimensions of a hydraulic fracture, the dimensions including fracture height and length, fracture width and fluid pressures as a function of time,

(e) converting said first set of values into a set of output data, the output data representing fracture dimensions and pressures as a function of pumping time,
(f) displaying the output data on a computer monitor.

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2. The device of claim 1 further wherein the step of determining from said first set of values dimensions of a hydraulic fracture is achieved using a mesh of elements.

10 3. The device of claim 1 wherein the elements may in some cases be only partially active.

15 4. The device of claim 2 further wherein during the determining step recalculation of fully active elements is not required during determination of said first set of values.

20 5. The device of claim 2 further wherein the elements are segregated into subterranean geological layers such that stresses and strains corresponding to respective elements within a given subterranean geological layer will be represented in the output data.

25 6. A device comprising means for storing instructions, said instructions adapted to be executed by a processor of a

computer, said instructions when executed by the processor
executing a process comprising the steps of

(a) obtaining a first data set, the first data set
comprising one or more of the following:

5 time history of fluid volumes for pumping,
 time history of proppant volumes for pumping,
 fluid properties,
 proppant properties, and
 logs of geological information,

10 (b) providing the first data set to a computer, the
 computer having a processor capable of executing
 instructions, the computer further having electronic storage
 means with stored equations comprising hydraulic fracturing
 relationships,

15 (c) computing by said processor a first set of values
 by manipulating said first data set using said stored
 equations,

20 (d) determining from said first set of values the
 dimensions of a hydraulic fracture using a mesh of elements,
 said dimensions including fracture height and length,
 fracture width and fluid pressures as a function of time,
 wherein the elements are capable of being only partially
 active, further wherein the recalculation of fully active
 elements is not required during determination of said first
25 set of values,

(e) converting said first set of values into a set of output data, the output data representing fracture dimensions and pressures as a function of pumping time,

(f) displaying, transmitting, or printing the output data.

7. A method of designing a hydraulic fracture of a well, comprising:

(a) obtaining a first data set, the first data set comprising one or more of the following:

time history of fluid volumes for pumping,
time history of proppant volumes for pumping,
fluid properties,
proppant properties, and
logs,

(b) providing the first data set to a computer, the computer having a processor capable of executing instructions, the computer further having electronic storage means with stored equations comprising hydraulic fracturing relationships,

(c) computing by said processor a first set of values by manipulating said first data set using said stored equations,

(d) determining from said first set of values the dimensions of a hydraulic fracture using a mesh of elements, said dimensions including fracture height and length,

fracture width and fluid pressures as a function of time,
wherein the elements are capable of being only partially
active, further wherein the recalculation of fully active
elements is not required during determination of said first
5 set of values,

(e) converting said first set of values into a set of
output data, the output data representing fracture
dimensions and pressures as a function of pumping time,

(f) displaying the output data.

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8. A method for monitoring or evaluating the fracture
of a well in real time, comprising:

(a) pumping a fracturing fluid into a wellbore,

(b) obtaining a first data set, the first data set

15 comprising one or more of the following:

time history of fluid volumes for pumping,

time history of proppant volumes for pumping,

fluid properties,

proppant properties, and

20 logs,

(c) providing the first data set to a computer, the
computer having a processor capable of executing
instructions, the computer further having electronic storage
means with stored equations comprising hydraulic fracturing
25 relationships,

(d) computing by said processor a first set of values by manipulating said first data set using said stored equations,

5 (e) determining from said first set of values the dimensions of a hydraulic fracture using a mesh of elements, said dimensions including fracture dimensions and fluid pressures as a function of time, wherein the elements are capable of being only partially active, further wherein the recalculation of fully active elements is not required
10 during determination of said first set of values,

(f) converting said first set of values into a set of output data, the output data representing fracture dimensions and pressures as a function of pumping time,

(g) displaying the output data, and

15 (h) monitoring the pumping step (a) to determine fracturing performance in real time.

9. A method of evaluating the fracture of a well following a fracturing operation, comprising:

20 (a) fracturing a well,

(b) obtaining a first data set, the first data set comprising one or more of the following data points obtained during step (a):

25 time history of fluid volumes for pumping,
time history of proppant volumes for pumping,
fluid properties,

proppant properties, and
logs,

(c) providing the first data set to a computer, the
computer having a processor capable of executing
5 instructions, the computer further having electronic storage
means with stored equations comprising hydraulic fracturing
relationships,

(d) computing by said processor a first set of values
by manipulating said first data set using said stored
10 equations,

(e) determining from said first set of values the
dimensions of a hydraulic fracture using a mesh of elements,
said dimensions including fracture dimensions and fluid
pressures as a function of time, wherein the elements are
15 capable of being only partially active, further wherein the
recalculation of fully active elements is not required
during determination of said first set of values,

(f) converting said first set of values into a set of
output data, the output data representing fracture
20 dimensions and pressures as a function of pumping time,

(g) displaying the output data.

10. An article of manufacture, comprising:

(a) magnetic storage means having encoded thereon
25 instructions,

(b) a computer, the computer having a processor,
wherein the processor is operably connected to said magnetic
storage means,

(c) wherein data is provided representing the time
5 history of fluid volumes, fluid properties, and proppant
properties required to fracture a reservoir of a reservoir,

(d) the processor being adapted to calculate values
that correlate to said data, the values representing
physical properties related to the reservoir or well
10 fracturing operations using fluids, the values being used to
estimate fracturing fluid performance,

(e) the processor being capable of processing such data
using numerical methods that subdivide a fracture numerical
mesh into elements for purposes of calculation, said
15 elements being generally capable of adopting a status as
fully active, partially active, or inactive for calculation
purposes, further wherein recalculation of fully active
elements is not required.

20 11. The article of manufacture of claim 10 further
wherein the processor is instructed to effectively calculate
an accurate simulation of a fracturing procedure while using
minimal computing power and substantially avoiding
recalculation.

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12. A system adapted to process data to optimize the placement of a fracture in a subterranean formation, comprising:

- 5 (a) obtaining a first data set, the first data set comprising one or more of the following:
- time history of fluid volumes for pumping,
 - time history of proppant volumes for pumping,
 - fluid properties,
 - proppant properties, and
 - 10 logs identifying geological zones in a reservoir,
- (b) providing the first data set to a computer, the computer having a processor capable of executing instructions, the computer further having electronic storage means with stored equations comprising hydraulic fracturing relationships,
- 15 (c) computing by said processor a first set of values by manipulating said first data set using said stored equations,
- (d) determining from said first set of values the
- 20 dimensions of a hydraulic fracture using a mesh of elements, said dimensions including fracture dimensions and fluid pressures as a function of time, wherein the elements are capable of being only partially active, further wherein the recalculation of fully active elements is not required
- 25 during determination of said first set of values,

(e) converting said first set of values into a set of output data, the output data representing fracture dimensions and pressures as a function of pumping time, and
(f) displaying the output data.

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13. A method comprising:

(a) obtaining a first data set,

(b) providing the first data set to a computer, the computer having a processor capable of executing instructions, the computer further having electronic storage means with stored equations comprising hydraulic fracturing relationships, the relationships comprising a Fourier Transform solution of multilayer equilibrium equations, the solution employing at least one inversion process,

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(c) computing by said processor a first set of values by manipulating said first data set using said stored equations, the equations including a Green's function or influence matrix,

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(d) determining the dimensions of a hydraulic fracture using a mesh of elements,

(e) converting said first set of values into a set of output data, the output data representing fracture dimensions and pressures as a function of pumping time.

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14. The method of claim 13 further comprising the step of:

(f) displaying the data for a user.

15. The method of claim 13 further comprising the step of:

5 (f) sending the data to a remote site by way of a transmission medium.

16. The method of claim 13 further comprising the step of:

10 (f) printing the output data.

17. A device comprising a pre-recorded means readable by a computer and carrying instructions for a process, the instructions comprising the steps of:

15 (a) obtaining a first data set,

(b) providing the first data set to a computer, the computer having a processor capable of executing instructions, the computer further having pre-recorded means with stored equations comprising hydraulic fracturing relationships, the relationships comprising a Fourier Transform solution of multilayer equilibrium equations, the solution employing at least one inversion process,

20 (c) computing by said processor a first set of values by manipulating said first data set using said stored equations, the equations including a Green's function or influence matrix,

(d) determining the dimensions of a hydraulic fracture using a mesh of elements, and

(e) converting said first set of values into a set of output data, the output data representing fracture
5 dimensions and pressures as a function of pumping time.

18. The device of claim 17, wherein said pre-recorded means is selected from the group of magnetic tape, a magnetic disk, an optical disk, a CD-ROM.

19. A report generated by illustrating a characteristic or set of values for a fracturing operation of a formation penetrated by a wellbore, said formation having a reservoir of oil or gas, comprising the steps of:

15 (a) obtaining a first data set,

(b) providing the first data set to a computer, the computer having a processor capable of executing instructions, the computer further having pre-recorded means with stored equations comprising hydraulic fracturing
20 relationships, the relationships comprising a Fourier Transform solution of multilayer equilibrium equations, the solution employing at least one inversion process,

(c) computing by said processor a first set of values by manipulating said first data set using said stored
25 equations, the equations including a Green's function or influence matrix,

(d) determining the dimensions of a hydraulic fracture using a mesh of elements,

(e) converting said first set of values into a set of output data, the output data representing fracture

5 dimensions and pressures as a function of pumping time, and

(f) generating a report.

20. A data processing system for managing and observing the variables used in fracturing of a subterranean formation, comprising:

(a) computer processor means for processing data;

(b) storage means for storing data on a storage medium;

(c) first means for initializing the storage medium;

(d) second means for processing data regarding fracturing fluid time histories, fluid volumes, fluid properties, and geological properties;

(e) third means for processing data using equations having established known mathematical relationships into a first set of values;

(f) fourth means for converting said first set of values into a set of output data; and

(g) fifth means for displaying, printing, or otherwise transferring said output data to a receiving means, wherein the receiving means is capable of optimizing fracture

25 performance.